High-Frequency Antenna Arrays and Coupling Structures

Completed Technology Project (2011 - 2012)

Project Introduction

We are fabricating antenna arrays and coupling structure for frequencies in the 200-300 GHz frequency bands. The primary motivation of this work is to develop antenna coupling for superconducting ultra-compact spectrometer on a chip at millimeter- and submillimeter-wave bands. One of the key requirements for these spectrometers, which will have hundreds of pixels, is to have antenna arrays with high coupling efficiency, low reflections, and good Gaussian beam patterns.

An ultra-compact superconducting on-chip-spectrometer has the potential to revolutionize far-IR through millimeter-wave observational astronomy and astrophysics, allowing for the first time wide-field mm- and sub-mm spectral surveys and efficient follow up observations of known sources. Our ultimate plan is to use planar lithography to fabricate superconductin g transmission line filters to sort incident radiation by frequency to an array of direct detectors such as MKIDs. However, for this task, we are only focusing on the antenna array element and coupling structures which will couple energy from the telescope to the spectrometer chip. We will design and fabricate a 2x2 array of multi-flare-angle smooth walled horn array to demonstrate the feasibility of this concept for the spectrometer-on-a-chip as well as other focal plane arrays in the submillimeter-wave frequency band. The 2x2 horn array antennas will be fabricated using a tool which can make hundreds of arrays of horn antennas without much difficulty. This is the key innovation of this approach. The horn array will be designed for the 190-320 GHz frequency band. We will also design and fabricate a 2x2 array of circular to rectangular transition block which will be used to test the performance of the horn array. Fig. 1 shows the design concept and that fabrication tool that will enable fabrication of antenna arrays with hundreds of pixels.

Anticipated Benefits

An ultra-compact spectrometer-on-a-chip, when fully developed, will simultaneously image and extract full spectral information (including redshifts) from galaxies in the instrument field-of-view, a powerful new capability for studies of galaxy evolution and large-scale structure. It can be incorporated in Japanese-led SPICA space telescope's BLISS spectrometer instrument. It would enhance and extend the long wavelength capability of BLISS or a similar instrument.

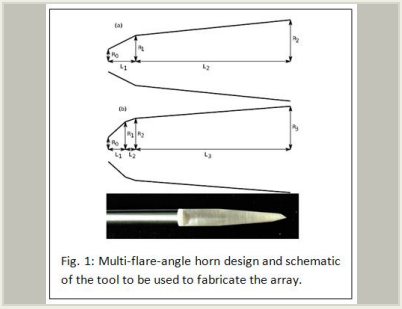


Fig. 1: Multi-flare-angle horn design and schematic of the tool to be used to fabricate the array.

Project Image High-Frequency Antenna Arrays and Coupling Structures

Table of Contents

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

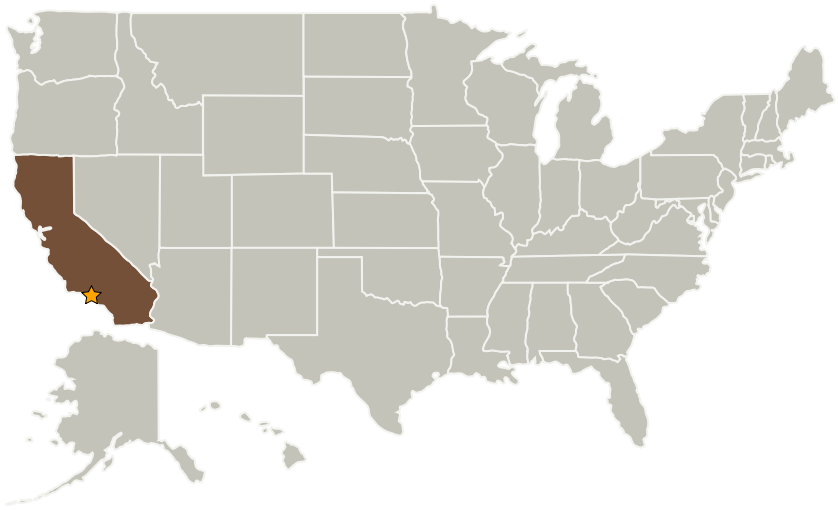
Responsible Program:

Center Innovation Fund: JPL CIF

High-Frequency Antenna Arrays and Coupling Structures

Completed Technology Project (2011 - 2012)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California

Co-Funding Partners	Type	Location
California Institute of Technology(CalTech)	Academia	Pasadena, California

Primary U.S. Work Locations
California

Project Management

Program Director:
Michael R Lapointe

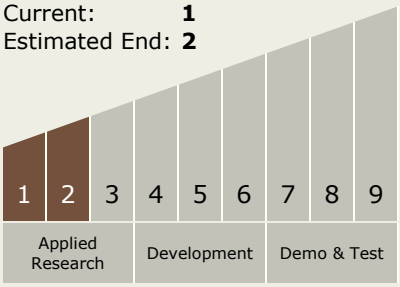
Program Manager:
Fred Y Hadaegh

Project Manager:
Jonas Zmuidzinas

Principal Investigator:
Goutam Chattopadhyay

Technology Maturity (TRL)

Start: **1**
Current: **1**
Estimated End: **2**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.2 Observatories
    - TX08.2.2 Structures and Antennas

Images

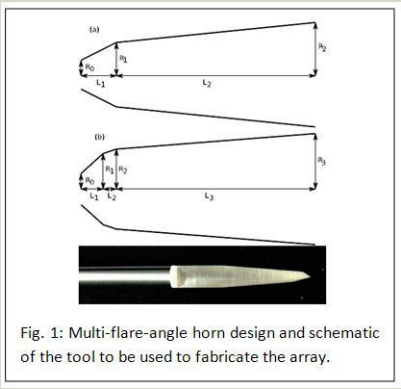


Fig. 1: Multi-flare-angle horn design and schematic of the tool to be used to fabricate the array.

69.jpg
Project Image High-Frequency Antenna Arrays and Coupling Structures
(https://techport.nasa.gov/image/1163)